

RAPID BIOASSESSMENT OF THE
BLUE RIVER AND UPPER EEL RIVER WATERSHEDS
USING BENTHIC MACROINVERTEBRATES

for the Soil and Water Conservation Districts of
Noble & Whitley Counties

Study conducted during
June and October 1994

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EXECUTIVE SUMMARY

A rapid bioassessment of the benthic communities of the Blue and upper Eel Rivers in northeastern Indiana was conducted in June and October 1994. The purpose of the assessment was to document the degree of biological impairment present in the waterbodies prior to initiation of various land treatments.

The study showed that all five sites examined were "slightly" to "moderately" impacted, compared to a nearby "reference" stream. Although lower aquatic habitat values at each study site contributed to observed biological impacts, degraded water quality appeared to be a problem as well. The most likely cause of lower water quality at these sites was nutrient enrichment and/or sediment deposition.

There was a strong indication that water quality improved at several sites between the June and October sampling periods. For example, the two Eel River sites had biological index scores indicating "moderate" impairment in June but only "slight" impairment in October. The reason for this improvement is not clear, but the numbers of sediment-intolerant animals did not increase between sampling periods. Therefore, decreased rates of sediment deposition are probably not responsible for the improvement.

The most biologically depressed site occurred in the Eel River downstream from Blue River. Previous studies have shown that this site also had the lowest biotic index value for fish communities in the Eel River system. Water quality problems other than sedimentation may contribute to the depressed conditions at this site.

INTRODUCTION

This study was conducted to measure the "biological integrity" of the Blue and upper Eel Rivers in northeastern Indiana. Both streams have been identified by the Soil and Water Conservation Districts of Whitley and Noble Counties and by the Indiana Department of Environmental Management (IDEM) as having seriously degraded water quality due to nonpoint sources of pollution [1]. By conducting studies of the biological community of the Blue and Eel Rivers before and after application of land treatments in the watershed, the study can help determine whether treatments resulted in improved water quality as reflected by an improved aquatic biological community.

Land treatments in the watershed were initiated in October 1993 and continued through the summer of 1994. The first study of the biological communities of these streams was conducted in June 1994. The second study was conducted in October 1994, shortly after completion of all land treatments planned for the watershed.

Local Setting

Blue River and the upper Eel River lie in the "Eastern Corn Belt Plain" ecoregion of the Central U.S. This area is composed of a glacial till plain broken by various glacial features, including glacial lakes. The natural vegetation consists of a diverse beech/maple and oak/hickory forest. Soils are composed of loamy glacial till. About 75% of the ecoregion is in cropland, primarily for corn and soybeans [2].

Blue River is a "fourth order" stream with a total watershed area of about 180 square kilometers. The upper watershed includes several glacial lakes having a total surface area of about 260 hectares. The watershed is extensively farmed and the Blue River is highly channelized to enhance drainage in most areas.

Eel River upstream from Blue River is also a "fourth order" stream. Total watershed area is about 265 square kilometers, but only one small natural lake is present. Like Blue River, the upper Eel River is also extensively channelized for drainage.

Five sites were chosen for study in these watersheds (Fig. 1). The selection of each site was dependent primarily on where land treatments were to be applied. A summary of each site and its watershed area is shown below:

Site 2	Blue River @ Hwy 33	55 square kilometers
Site 3	Blue River near Riley Rd.	125 square kilometers
Site 4	Blue River @ Hwy 30	200 square kilometers
Site 5	Eel River @ CR 200 S	200 square kilometers
Site 6	Eel River @ Washington Rd.	475 square kilometers

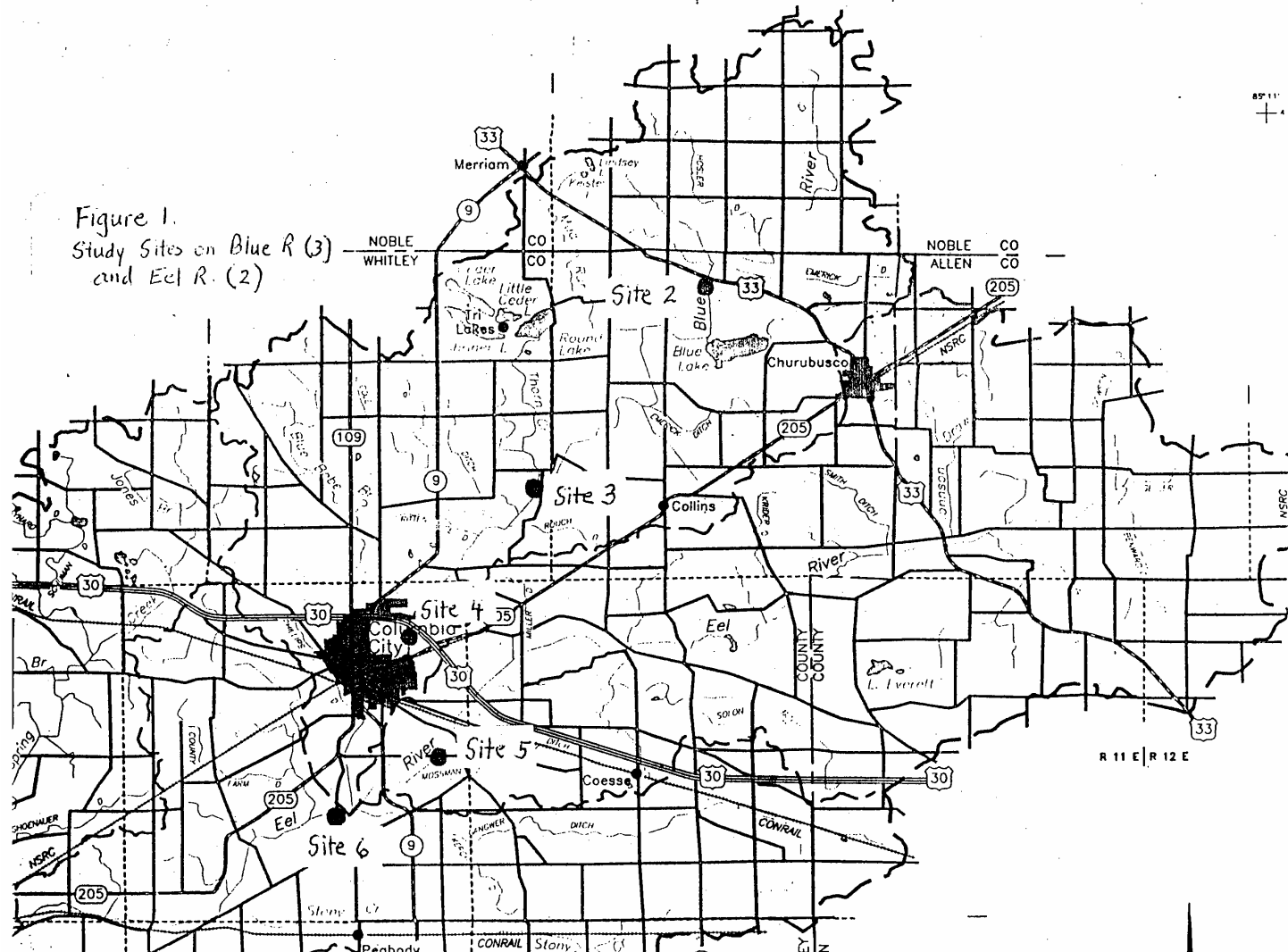
METHODS

Because they are considered to be more sensitive to local conditions and respond relatively rapidly to change [3], benthic (bottom-dwelling) organisms were used to document the biological condition of both Blue River and Eel River. The U.S. Environmental Protection Agency (EPA) has recently developed a "rapid bioassessment" protocol [4] which has been shown to produce highly reproducible results that accurately reflect changes in water quality. We used EPA's Protocol III to conduct this study. Protocol III requires a standardized collection technique, a standardized subsampling technique, and identification of at least 100 animals from each site to the genus or species level from both "study sites" and a "reference site."

Reference Site

The upper Tippecanoe River was chosen as the "reference site" for this study. This stream, which like Blue River and Eel River is a tributary of the Wabash River, has been identified by numerous aquatic biologists as having an extremely diverse aquatic community with many "pollution intolerant" organisms present [e.g. 5]. The site chosen for study lies downstream from Baugher Lake near the small town of Wilmot in Noble County. At this location, the Tippecanoe River drains an area of about 85 square kilometers. This watershed also includes several glacial lakes having a total surface area of about 380 hectares. Agriculture is also an important land use in this watershed, but the stream is less extensively channelized than either Blue River or the upper Eel River.

Figure 1.
Study Sites on Blue R. (3)
and Eel R. (2)



Sample Collection

Samples in this study were collected by kicknet from "snag" habitat where current speed was 20-30 cm/sec. Snags were used because they were the most important benthic habitat present at all of the six study sites. At least three snags (submerged, immovable wood from tree limbs fallen into the river) were identified at each site. The kicknet was placed immediately downstream from the snag habitat while the sampler used a hand to dislodge all attached benthic organisms. The organisms were swept by the current into the kicknet and subsequently transferred to a white pan. Each sample was examined in the field to assure that at least 100 organisms were collected at each site. In addition, each site was sampled for organisms in CPOM (coarse particulate organic matter, usually consisting of leaf packs from fast-current areas). All samples were preserved in the field with 70% isopropanol.

Laboratory Analysis

In the laboratory, a 100 organism subsample was prepared from each site by evenly distributing the whole sample in a white, gridded pan. Grids were randomly selected and all organisms within grids were removed until 100 organisms had been selected from the entire sample.

Each animal was identified to the lowest practical taxon (usually genus or species). As each new taxon was identified, a representative specimen was preserved as a "voucher." All voucher specimens will ultimately be deposited in the Purdue University Department of Entomology collection.

Data Analysis

Following identification of the animals in the sample, eight "metrics" are calculated for each site. These metrics are based on knowledge about the sensitivity of each species to changes in environmental conditions and how the benthic communities of unimpacted streams are usually organized. For example, EPT animals consist of those in the insect orders Ephemeroptera, Plecoptera, and Trichoptera, which are known to be more sensitive than most other benthic animals to degradation of environmental conditions. Feeding behaviors such as "scrapers," "filterers," and "shredders" change predictably under different conditions. The sum of all eight metrics provides an individual "biotic score" for each site.

Quality Assurance

To help assure the quality of the results, a duplicate sample was collected at Site 4 during October. The biological scores of each sample were measured to determine the amount of variability associated with the technique. Ideally, the individual scores of duplicate samples should be within about 10% of the mean score to assure that reproducible results are obtained.

RESULTS

Quality Assurance

The biotic index scores of site 4, as determined by duplicate samples, were 22 and 26, respectively, during the October sampling period (see Appendix). These values were within 10% of the mean and the use impairment categories obtained by both samples were identical. This indicates that the bioassessment technique produced reliable results during this study period.

Aquatic Habitat Analysis

When the EPA habitat scoring technique was used, the following aquatic habitat values were obtained for each site in the study:

	Score	% of Reference
Tippecanoe River (reference, Site 1)	98	100
Upper Blue River (Site 2)	91	93
Middle Blue River (Site 3)	62	63
Lower Blue River (Site 4)	73	75
Upstream Eel River (Site 5)	69	70
Downstream Eel River (Site 6)	80	82

The maximum value obtainable by this scoring technique is 135, with higher values indicating better habitat. Sites with lower habitat values normally have lower biotic index values as well.

The scores indicate that the lowest habitat value in this study was at Site 2 (Blue River near Riley Road). This site was characterized by extremely steep, unvegetated bank slopes with no riparian vegetation. All study sites also suffered from various degrees of channel alteration, lack of shading, and sediment deposition.

Water Quality Measurements

June 1994

	D.O. mg/l	pH SU	Cond. uS	Temp. (F)
Reference Site 1	9.7	8.3	330	73
Time-5:30 pm (6/1/94)				
Site 2	8.8	7.6	500	68
Time-8:00 pm (6/1/94)				
Site 3	7.7	7.4	530	68
Time-6:50 pm (6/1/94)				
Site 4	9.5	7.6	560	60
Time-9:15 am (6/2/94)				
Site 5	9.6	7.5	570	60
Time-10:30 am (6/2/94)				
Site 6	10.0	7.6	600	62
Time-11:30 am (6/2/94)				

Water Quality Measurements

October 1994

	D.O. mg/l	pH SU	Cond. uS	Temp. (F)
Reference Site 1	11.0	7.6	550	48
Time-4:45 pm (10/11/94)				
Site 2	11.0	7.6	590	47
Time-3:45 pm (10/11/94)				
Site 3	11.3	7.2	610	49
Time-2:45 pm (10/11/94)				
Site 4	11.5	7.6	610	47
Time-1:30 pm (10/11/94)				
Site 5	11.1	7.8	640	50
Time-10:30 am (10/11/94)				
Site 6	11.0	7.8	620	51
Time-12:15 pm (10/11/94)				

D.O. = Dissolved Oxygen

Cond. = Conductivity

Temp. = Temperature in Degrees Fahrenheit

Table 1.
Rapid Bioassessment Results - Blue and Eel Rivers - June 1994

	Site #					
	1	2	3	4	5	6
Chironomidae (Midges)						
Cricotopus bicinctus		14	21	13	48	18
C. trifascia		1	19	18	2	35
C. intersectus			1			
C. sylvestris		1				9
Eukiefferiella bavarica				1		
E. potthasti		2	5			6
Brillia flavifrons		2	5			
Orthocladus obumbratus			3	2	1	3
Glyptotendipes sp.					1	
Chironomus sp.			1			
Endochironomus nigricans					1	
Stenochironomus sp.		1		1	3	
Polypedilum convictum		3				
P. illinoense	1	1	1			2
P. fallax		13				
Tanytarsus sp.		1			2	
Rheotanytarsus sp.		5				
Microtendipes caelum	4					
Harnischia sp.	1					
Thienemannymia gr.	10	4			3	2
Simuliidae (Blackflies)		2		5	3	12
← Ephemeroptera (Mayflies)						
Stenacron interpunctatum		1		1	1	
Stenonema vicarium		1				
Stenonema immatures	1					
Baetis flavistriga		16	10	13		
B. brunneicolor		10	7	11		
B. amplus		1	1			
Baetis immatures		1	12	23	2	4
Pseudocloeon	1					
Caenis		3	2			
Trichoptera (Caddisflies)						
Ceraclea	4				1	
Cheumatopsyche			2	2	6	2
Hydropsyche betteni		1	2	2	2	2
H. dicantha			1	3		1
Ceratopsyche bifida		1	1	3	1	
Plecoptera (Stoneflies)						
Isoperla		3				
Phasganophora	32		1			

Table 1 (continued)
Rapid Bioassessment Results - Blue and Eel Rivers - June 1994

	Site #					
	1	2	3	4	5	6
Coleoptera (Beetles)						
Ancyronyx variegata					2	
Macronychus glabratus	3	3	3		5	
Stenelmis	1					
Dubiraphia		7	1		11	2
Odonata (Dragonflies)						
Aeshna				1		
Amphipoda (Scuds)						
Hyalella azteca	8					
Isopoda (Pillbugs)						
Caecidotea	22				5	2
Gastropoda (Snails)						
Gyraulus deflectus	3	1				
Amnicola limosa	7					
other Pleuroceridae	1					
Ferrissia	1					
Pelecypoda (Clams)						
Pisidium			1			
Oligochaeta (Worms)						
Tubificidae		1		1		
Total	100	100	100	100	100	100

Table 2. Data Analysis - June 1994

METRICS

	Site #					
	1	2	3	4	5	6
# of Genera	15	20	15	12	18	11
Biotic Index	5.1	6.3	6.6	6.2	7.5	7.2
Scrapers/Filterers	>17	3.3	0.6	0.07	1.6	0.0
EPT/Chironomids	2.4	0.8	0.7	1.7	0.2	0.1
% Dominant Taxon	30	16	21	25	48	35
EPT Index	4	7	6	5	6	3
Community Loss Index	0.0	0.5	0.8	>1.3	0.6	1.1
% Shredders (CPOM)	53	6.1	0.0	0.0	1.3	3.0

SCORING

	Site #					
	1	2	3	4	5	6
# of Genera	6	6	6	4	6	4
Biotic Index	6	4	4	4	2	4
Scrapers/Filterers	6	2	0	0	0	0
EPT/Chironomids	6	2	2	4	0	0
% Dominant Taxon	4	6	4	4	0	2
EPT Index	6	6	6	6	6	2
Community Loss Index	6	4	4	2	4	4
% Shredders (CPOM)	6	0	0	0	0	0
TOTAL	46	30	26	24	18	16
% of Reference	100	65	56	52	39	35
Impairment Category	N	S	S	M	M	M

N = NONE

S = SLIGHT

M = MODERATE

Table 3.
Rapid Bioassessment Results - Blue and Eel Rivers - October 1994

	Site #					
	1	2	3	4	5	6
Chironomidae (Midges)						
Cricotopus bincinctus		7	2	2	2	15
C. sylvestris						1
Orthocladius obumbratus		16	1	5	4	2
Dicrotendipes neomodestus					12	
Glyptotendipes sp.					10	2
Endochironomus subtendens					1	
Stenochironomus sp.		1			5	2
Polypedilum convictum	1				2	1
Parametriocneumus lundbecki		1				
Paralauterborniella sp.				1		
Paratanytarsus sp.		5			6	1
Psectrocladius psilopterus					2	1
Microtendipes caelum		2				1
Thienemannymia gr.	3	2	4	1	15	2
Tipulidae						
Tipula sp.		2				
Simuliidae (Blackflies)				5		1
Empididae		1			1	
Ephemeroptera (Mayflies)						
Stenacron interpunctatum	3			2	5	1
Stenonema vicarium		2	1	1		
Baetis flavistriga	1	4	1	10		
B. brunneicolor		3	16	16		2
B. intercalaris			3			8
Isonychia sayi			1			
Caenis sp.					1	
Tricorythodes sp.					2	7
Trichoptera (Caddisflies)						
Ceraclea	1					
Cheumatopsyche	6	15	15	5	14	24
Hydropsyche betteni		11	16	35	1	17
H. dicantha		12	13			4
H. cuanis				5		
Ceratopsyche bifida		8	21	8	1	3
Chimarra obscura	2					
Helicopsyche borealis	15					
Lepidostomata sp.		2				
Lepidoptera (Moths)						
Parargyractis sp.	1					

Table 3 (continued)
 Rapid Bioassessment Results - Blue and Eel Rivers - October 1994

	Site #					
	1	2	3	4	5	6
Coleoptera (Beetles)						
Macronychus glabratus	1	4	1	2		
Stenelmis	16				1	
Dubiraphia	2		4		4	2
Odonata (Dragonflies)						
Calopteryx sp.	1	1			5	1
Aeschna sp.				1		
Amphipoda (Scuds)						
Hyaella azteca	17				4	1
Isopoda (Pillbugs)						
Caecidotea so,					1	1
Lirceus sp.	7					
Gastropoda (Snails)						
Gyraulus deflectus	4				1	
Amnicola limosa	1					
Elimia livescens	12					
Ferrissia rivularis	1			1		
Physella sp.			1			
Pelecypoda (Clams)						
Sphaerium sp.	1					
Turbellaria (Flatworms)	4					
Total	100	100	100	100	100	100

Table 4. Data Analysis - October 1994
METRICS

	Site #					
	1	2	3	4	5	6
# of Genera	22	18	12	11	14	23
Biotic Index	5.2	5.8	4.7	6.1	7.3	6.7
Scrapers/Filterers	4.6	0.04	0.03	0.07	0.3	0.02
EPT/Chironomids	7.0	1.7	13	9.1	0.4	2.4
% Dominant Taxon	17	16	21	35	15	24
EPT Index	6	7	6	6	6	6
Community Loss Index	0.0	0.9	1.4	1.2	0.6	0.9
% Shredders (CPOM)	8	7	1	0	3	0

SCORING

	Site #					
	1	2	3	4	5	6
# of Genera	6	6	2	4	6	6
Biotic Index	6	6	6	4	4	4
Scrapers/Filterers	6	0	0	0	0	0
EPT/Chironomids	6	2	6	6	0	2
% Dominant Taxon	6	6	4	2	6	4
EPT Index	6	6	6	6	6	6
Community Loss Index	6	4	4	4	4	4
% Shredders (CPOM)	6	6	0	0	2	0
TOTAL	48	36	28	26	28	26
% of Reference	100	75	58	54	58	54
Impairment Category	N	S	S	S	S	S

N = NONE

S = SLIGHT

M = MODERATE

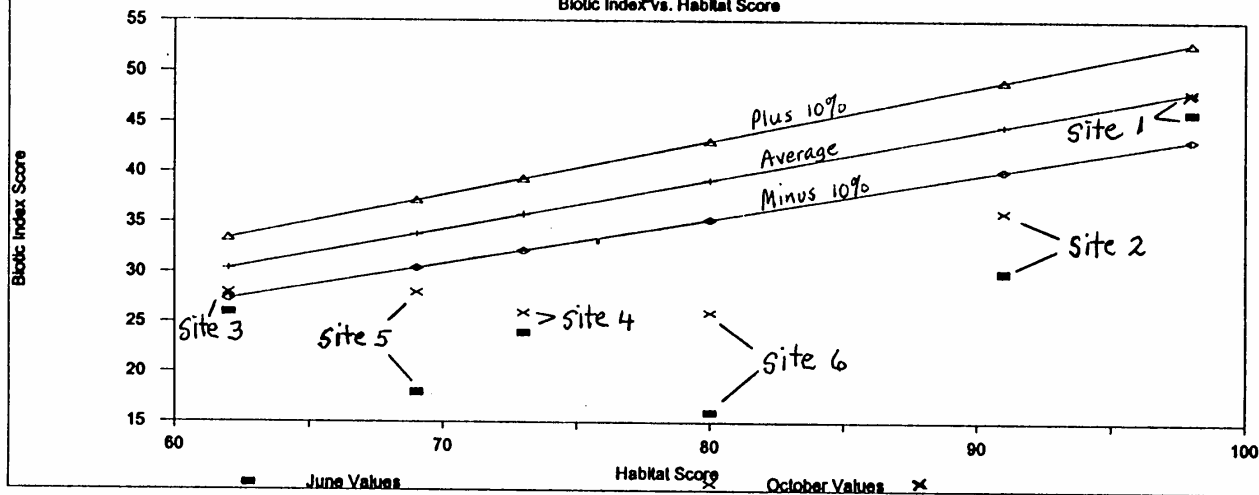
DISCUSSION

A total of 38 macroinvertebrate genera were collected at the six sites during June. The most commonly collected species at most study sites during this first study period were the midges Cricotopus bicinctus and Cricotopus trifascia. Many water quality scientists regard an abundance of C. bincinctus as an indicator of toxic conditions [e.g. 6]. However, this species is also known from relatively clean-water streams. For example, both C. bincinctus and C. trifascia were among the most common benthic species observed in a headwater agricultural stream in southern Ontario [7]. Since EPT taxa, known to be sensitive to most toxicants, were also observed at each of the Blue and Eel River study sites, it is unlikely that toxicants were responsible for the water quality impairment observed at each study site.

Figure 2 shows the normal relationship of biotic index scores to habitat values (a linear relationship according to [4]). The figure also shows a range of plus or minus 10%. When biotic index values fall outside this range, the site typically has degraded water quality. Figure 2 indicates that sites 2,4,5, and 6 had biotic values considerably lower than expected from their measured habitat values during the June sampling period. Therefore, these sites were probably affected by both degraded habitat and degraded water quality. Site 6 deviated farthest from the normal relationship, indicating that its water quality may have been worse than the other sites.

By autumn, 45 genera of macroinvertebrates were present at the six sites. The predominance of Cricotopus midges declined sharply during the October sampling period. Instead, most samples were dominated by net-spinning caddisflies. Figure 2 shows that, during October, sites 2, 5, and 6 had improved biotic index values much closer to the values predicted by their habitat scores. In addition, Table 4 shows that Sites 5 and 6 had improved from "moderately impacted" in June to "slightly impacted" during October.

Figure 2
Biotic Index vs. Habitat Score



An examination of those metrics showing the greatest difference from the reference stream may provide an important clue about causes of biological impairment. During June, all study sites had few "scraper" or "shredder" organisms and a greater dominance by one or two species than the reference stream. Also most study sites had much higher numbers of chironomids than "EPT" organisms. Several of these indicators are common to many types of perturbations. However, the decline of scraper-type organisms often accompanies a decline in diatoms and a rise in filamentous algae associated with nutrient enrichment [4]. The study sites also had far more "sediment-tolerant" animals and fewer "sediment-intolerant" animals than the reference site (see Tables 5 and 6).

A similar trend in the types of metrics most affected at the study sites was apparent during the October sampling period. However, several metrics at the two Bel River sites (e.g. % dominant taxon, % shredders, EPT taxa) were much closer to the reference in October than in June, indicating a significant improvement in water quality. The percentage of sediment-intolerant organisms did not change much between sampling periods, so decreased sedimentation was probably not responsible for the observed improvements (see Table 6).

Table 5. Sediment-Tolerant Species Observed
(References shown in brackets)

Cheumatopsyche sp.	[8]	[9]
Hydropsyche betteni	[8]	
Baetis intercalaris	[8]	
(close to B. flavistriga)		
B. amplus	[8]	
Caenis sp.	[9]	[11]
Tricorythodes	[9]	[15]
Polypedilum convictum	[9]	
Rheotanytarsus sp.	[9]	
Chironomus sp.	[6]	
Thienemannymia group	[9]	
Calopteryx spp.	[9]	
Macronychus glabratus	[9]	
Tubificidae	[11]	

SEDIMENT-TOLERANT ORGANISMS

June Samples		
% of All Organisms at the Reference Site		13%
% of All Organisms at the Study Sites		
Site 2	34%	
Site 3	26%	
Site 4	29%	
Site 5	16%	
Site 6	6%	
October Samples		
% of All Organisms at the Reference Site		12%
% of All Organisms at the Study Sites		
Site 2	38%	
Site 3	40%	
Site 4	53%	
Site 5	39%	
Site 6	58%	

Table 6. Sediment-Intolerant Species Observed
(References shown in brackets)

Plecoptera	[9]
Microtendipes sp.	[9]
Brillia sp.	[9]
Tipula sp.	[9]
Stenonema vicarum	[9]
Parargyractis sp.	[9]
Ceraclea sp.	[9]
Helicopsyche borealis	[9]
Hyalella azteca	[10]

SEDIMENT-INTOLERANT ORGANISMS

June Samples

% of All Organisms at the Reference Site	48%
% of All Organisms at the Study Sites	
Site 2	6%
Site 3	6%
Site 4	0%
Site 5	1%
Site 6	0%

October Samples

% of All Organisms at the Reference Site	34%
% of All Organisms at the Study Sites	
Site 2	6%
Site 3	1%
Site 4	1%
Site 5	4%
Site 6	2%

Comparison to Other Studies

There are no previously published studies of the benthic macroinvertebrate communities of these streams. However, the fish communities have been studied fairly extensively. Gammon & Gammon [12] observed that in the summer of 1990 both Blue River and the upper Eel River had relatively depressed fish communities, associated with low habitat value and high turbidity and sedimentation. It is interesting to note that Gammon and Gammon's lowest biotic index score occurred on the first Eel River site downstream from Blue River, where the lowest biotic index value was also observed in the present study.

Kittaka [13] reported even more recently that the fish community of Blue River in 1993 was dominated by "tolerant" species (those able to survive in conditions of poor water quality caused by sedimentation, toxic substances, or low dissolved oxygen, as well as in degraded habitat) and that "intolerant" fish are virtually absent from the stream. The habitat scores observed by both [12] and [13] were nearly identical to those obtained in the present study.

In contrast to these more recent studies, the fish community of the Blue River 50 years ago included several "intolerant" species which are not longer present. For example, Gerking [14] collected the rosyface shiner and the rainbow and orangethroat darters at his only collecting site on the Blue River in 1941. These species, which require good water quality and unaltered habitat, seem to have disappeared from the fauna in the last 50 years.

RECOMMENDATIONS

1. Continue to monitor these six sites during 1995 to determine whether a trend toward improvement in biological conditions has occurred after completion of land treatments.
2. Consider concentrating additional land treatment efforts on the middle segments of Blue River and its tributaries, where water quality degradation appears to be more severe than in the upper watershed.
3. Encourage local entities and landowners to provide some form of bank stabilization on Blue River downstream from Riley Road, where extremely steep banks are unvegetated and frequently slumping into the stream.
4. Consider expanding land treatment efforts in the upper Eel River watershed, where the biotic scores are lowest.
5. Study the stretch of Blue River between Highway 30 and its confluence with Eel River to determine potential sources of water quality degradation at Site 6 on Eel River. Potential sources are urban runoff, the Columbia City Wastewater Treatment Plant, or abandoned waste sites. This should be done in cooperation with the Indiana Department of Environmental Management.

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MUSSELS OBSERVED DURING THE STUDY

Tippecanoe River @ Site 1

Anodonta grandis - 2 valves
Villosa iris - 2 valves
Villosa lienosa - 2 valves

Blue River @ Site 2

Anodonta imbecilis - live
Lampsilis siliquoidea - 2 valves

Eel River @ Site 5

Anodonta grandis - live
Lampsilis siliquoidea - live

PHYSICAL CHARACTERIZATION/WATER QUALITY
FIELD DATA SHEET

6/1/94
Tippicanoe River (Site 1)

PHYSICAL CHARACTERIZATION

RIPARIAN ZONE/INSTREAM FEATURES

Predominant Surrounding Land Use:

Forest Field/Pasture Agricultural Residential Commercial Industrial Other

Local Watershed Erosion: None Moderate Heavy Some

Local Watershed BPS Pollution: No evidence Some Potential Sources Obvious Sources

Estimated Stream Width 4 m Estimated Stream Depth 0.2 m Run 0.5 m Pool

High Water Mark 0 Velocity 0 Don Present: Yes No Channelized: Yes No Not Recently

Canopy Cover: Open Partly Open Partly Shaded Shaded

SEDIMENT/SUBSTRATE:

Sediment Odors: Normal Sewage Petroleum Chemical Anaerobic None Other

Sediment Oils: Absent Slight Moderate Profuse

Sediment Deposits: Sludge Sandstun Paper Fiber Sand Shell Shells Other

Are the undersides of stones which are not deeply undercut black? Yes No

Inorganic Substrate Components

Substrate Type	Diameter	Percent Composition in Sampling Area
Bedrock		
Boulder	>256-mm (10 in.)	
Cobble	64-256-mm (2.5-10 in.)	<u>1%</u>
Gravel	3-64-mm (0.1-2.5 in.)	<u>50%</u>
Sand	0.06-2.00-mm (gritty)	<u>50%</u>
Silt	0.004-0.06-mm	
Clay	<0.004-mm (clay)	

Organic Substrate Components

Substrate Type	Characteristic	Percent Composition in Sampling Area
Detritus	Sticks, Wood, Coarse Plant Material (CPOM)	<u>10%</u>
Muck-Mud	Black, Very Fine Organic (FPOM)	
Rock	Grey, Shell Fragments	

P. crispus present

WATER QUALITY

Temperature 73 °F Dissolved Oxygen 9.8 pH 8.3 Conductivity 330 Other

Instrument(s) Used YSI Hanna Cole Parmer

Stream Type: Coldwater Warmwater

Water Odors: Normal Sewage Petroleum Chemical None Other

Water Surface Oil: Slick Sheen Globs Flochs None

Turbidity: Clear Slightly Turbid Turbid Opaque Water Color

WEATHER CONDITIONS

Sunny

PHOTOGRAPH NUMBER

numerous sphaerids present → sampled

OBSERVATIONS AND/OR SKETCH

HABITAT ASSESSMENT FIELD DATA SHEET

Tippecanoe River

6/1/94

Habitat Parameter	Category			
	Excellent	Good	Fair	Poor
1. *Bottom substrate/available cover ^(a)	Greater than 50% rubble, gravel, submerged logs, undercut banks, or other stable habitat. 16-20	30-50% rubble, gravel or other stable habitat. Adequate habitat. 11-15	10-30% rubble, gravel or other stable habitat. Habitat availability less than desirable. 6-10	Less than 10% rubble, gravel or other stable habitat. Lack of habitat is obvious. 0-5
2. Embeddedness ^(b)	Gravel, cobble, and boulder particles are between 0 and 25 % surrounded by fine sediment. 16-20	Gravel, cobble, and boulder particles are between 25 and 50 % surrounded by fine sediment. 11-15	Gravel, cobble, and boulder particles are between 50 and 75 % surrounded by fine sediment. 6-10	Gravel, cobble, and boulder particles are over 75 % surrounded by fine sediment. 0-5
3. ≤ 0.15 cms (5cfs) * "Flow ₄ " at rep. low flow ^(a)	Cold >0.05 cms (2 cfs) Warm >0.15 cms (5 cfs) 10-20	0.03-0.05 cms (1-2 cfs) 0.05-0.15 cms (2-5 cfs) 11-15	0.01-0.03 cms (.5-1 cfs) 0.03-0.05 cms (1-2 cfs) 6-10	<0.01 cms (.5 cfs) <0.03 cms (1 cfs) 0-5
or >0.15 cms (5cfs) * Velocity/depth	Slow (<0.3 m/s), deep (>0.5 m); slow, shallow (<0.5 m); fast (>0.3 m/s), deep; fast, shallow habitats all present. 16-20	Only 3 of the 4 habitat categories present (missing riffles or runs receive lower score than missing pools). 11-15	Only 2 of the 4 habitat categories present (missing riffles/runs receive lower score). 6-10	Dominated by one velocity/depth category (usually pool). 0-5
4. * Channel alteration ^(a)	Little or no enlargement of islands or point bars, and/or no channelization. 12-15	Some new increase in bar formation, mostly from coarse gravel; and/or some channelization present. 8-11	Moderate deposition of new gravel, coarse sand on old and new bars; pools partially filled w/silt; and/or embankments on both banks. 4-7	Heavy deposits of fine material, increased bar development; most pools filled w/silt; and/or extensive channelization. 0-3
5. Bottom scouring and deposition	Less than 5% of the bottom affected by scouring and deposition. 12-15	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools. 8-11	30-50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools. 4-7	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. Only large rocks in riffle exposed. 0-3

(a) From Ball 1982.

(b) From Platts et al. 1983.

Note: * = Habitat parameters not currently incorporated into BIOS.

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PHYSICAL CHARACTERIZATION/WATER QUALITY
FIELD DATA SHEET

Site 2.
Blue River - U/S - Hwy 38

PHYSICAL CHARACTERIZATION

RIPARIAN ZONE/INSTREAM FEATURES

Predominant Surrounding Land Use:

Forest Field/Pasture Agricultural Residential Commercial Industrial Other _____

Local Watershed Erosion: None Moderate Heavy _____

Local Watershed BPS Pollution: No evidence Some Potential Sources Obvious Sources _____

Estimated Stream Width 4 m Estimated Stream Depth: Dibble 0.1 m Sun _____ m Pool 1 m

High Water Mark _____ m Velocity 2.30 Dan Present: Yes _____ No ✓ Channelized: Yes ✓ No _____

Canopy Cover: Open Partly Open Partly Shaded Shaded _____

SEDIMENT/SUBSTRATE:

Sediment Odors: Normal Sewage Petroleum Chemical Anaerobic None Other _____

Sediment Oils: Absent Slight Moderate Profuse _____

Sediment Deposits: Sludge Sawdust Paper Fiber Sand Shell Shells Other _____

Are the undersides of stones which are not deeply embedded black? Yes No

Inorganic Substrate Components

Substrate Type	Diameter	Percent Composition in Sampling Area
Bedrock		
Boulder	>256-mm (10 in.)	
Cobble	66-256-mm (2.3-10 in.)	5%
Gravel	2-66-mm (0.1-2.3 in.)	40%
Sand	0.06-2.00-mm (gritty)	40%
Silt	0.004-0.06-mm	15%
Clay	<0.004-mm (clay)	

Organic Substrate Components

Substrate Type	Characteristic	Percent Composition in Sampling Area
Detritus	Sticks, Wood, Coarse Plant Materials (CPOM)	5%
Muck-Mud	Black, Very Fine Organic (FPOM)	
Hard	Gray, Shell Fragments	

WATER QUALITY

Temperature _____ C Dissolved Oxygen _____ pH _____ Conductivity _____ Other _____

Instrument(s) Used _____

Stream Type: Coldwater Warmwater

Water Odors: Normal Sewage Petroleum Chemical None Other _____

Water Surface Oils: Slick Sheen Globs Flocks None

Turbidity: Clear Slightly Turbid Turbid Opaque Water Color _____

WEATHER CONDITIONS

PHOTOGRAPH NUMBER

OBSERVATIONS AND/OR SKETCH

HABITAT ASSESSMENT FIELD DATA SHEET (cont.)

Tippecanoe River

6/1/94

Habitat Parameter	Category			
	Excellent	Good	Fair	Poor
6. Pool/riffle, run/bend ratio (distance between riffles divided by stream width)	5-7. Variety of habitat. Deep riffles and pools.	7-15. Adequate depth in pools and riffles. Bends provide habitat.	15-25. Occasional riffle or bend. Bottom contours provide some habitat.	>25. Essentially a straight stream. Generally all flat water or shallow riffle. Poor habitat.
	12-15	4-11	4-7	0-3
7. Bank stability ^(a)	Stable. No evidence of erosion or bank failure. Side slopes generally <30%. Little potential for future problem.	Moderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40% on one bank. Slight potential in extreme floods.	Moderately unstable. Moderate frequency and size of erosional areas. Side slopes up to 60% on some banks. High erosion potential during extreme high flow.	Unstable. Many eroded areas. Side slopes >60% common. "Raw" areas frequent along straight sections and bends.
	9-10	4-6	3-5	0-2
8. Bank vegetative stability	Over 80% of the streambank surfaces covered by vegetation or boulders and cobbles.	50-79% of the streambank surfaces covered by vegetation, gravel or larger material.	25-49% of the streambank surfaces covered by vegetation, gravel, or larger material.	Less than 25% of the streambank surfaces covered by vegetation, gravel, or larger material.
	9-10	6-8	3-5	0-2
9. Streamside cover ^(b)	Dominant vegetation is shrub.	Dominant vegetation is of tree form.	Dominant vegetation is grass or forbes.	Over 50% of the streambank has no vegetation and dominant material is soil, rock, bridge materials, culverts, or mine tailings.
	9-10	6-8	3-5	0-2
Column Totals				
Score	103		34	
	98			

PHYSICAL CHARACTERIZATION/WATER QUALITY
FIELD DATA SHEET

Site 3. 6/1/94
Blue River → Riley Rd.
(D/S Thorn Creek)

PHYSICAL CHARACTERIZATION

RIPARIAN ZONE/INSTREAM FEATURES

Predominant Surrounding Land Use:

Forest ☐ Field/Pasture ☐ Agricultural ☐ Residential ☐ Commercial ☐ Industrial ☐ Other ☐

Local Watershed Erosion: None ☐ Moderate ☐ Heavy ☐

Local Watershed BPS Pollution: No evidence ☐ Some Potential Sources ☐ Obvious Sources ☐

Estimated Stream Width 4 m Estimated Stream Depth: Riffle 0.2 m Run ☐ m Pool 0.5 m

High Water Mark ☐ Velocity >30 Dan Present: Yes ☐ No ☒ Channelized: Yes ☒ No ☐

Canopy Cover: Open ☐ Partly Open ☐ Partly Shaded ☐ Shaded ☐

SEDIMENT/SUBSTRATE:

Sediment Odors: Normal ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Anaerobic ☐ None ☐ Other ☐

Sediment Oils: Absent ☐ Slight ☐ Moderate ☐ Profuse ☐

Sediment Deposits: Sludge ☐ Sawdust ☐ Paper Fiber ☐ Sand ☐ Shell Shells ☐ Other ☐

Are the undersides of stones which are not deeply embedded black? Yes ☐ No ☐

Inorganic Substrate Components

Substrate Type	Diameter	Percent Composition in Sampling Area
Bedrock		
Boulder	>254-mm (10 in.)	1%
Cobble	64-254-mm (2.5-10 in.)	9%
Gravel	2-64-mm (0.1-2.5 in.)	40%
Sand	0.06-2.06-mm (gritty)	50%
Silt	<.064-mm	
Clay	<.004-mm (clay)	

Organic Substrate Components

Substrate Type	Characteristic	Percent Composition in Sampling Area
Detritus	Sticks, Wood, Coarse Plant Material (CPOM)	5%
Rock-Rud	Black, Very Fine Organic (FPOM)	
Hard	Grey, Shell Fragments	

WATER QUALITY

Temperature 68 °F Dissolved Oxygen 7.7 pH 7.4 Conductivity 530 Other ☐

Instrument(s) Used ☐

Stream Type: Coldwater ☐ Warmwater ☐

Water Odors: Normal ☐ Sewage ☐ Petroleum ☐ Chemical ☐ None ☐ Other ☐

Water Surface Oils: Slick ☐ Sheen ☐ Globes ☐ Flecks ☐ None ☐

Turbidity: Clear ☐ Slightly Turbid ☐ Turbid ☐ Opaque ☐ Water Color ☐

WEATHER CONDITIONS

recent bankside tree removal

PHOTOGRAPH NUMBER

OBSERVATIONS AND/OR SKETCH

HABITAT ASSESSMENT FIELD DATA SHEET

Blue River — Riley Rd.

Habitat Parameter	Excellent	Good	Fair	Poor
1. *Bottom substrate/available cover ^(a)	Greater than 50% rubble, gravel, submerged logs, undercut banks, or other stable habitat. 16-20	30-50% rubble, gravel or other stable habitat. Adequate habitat. 11-15	10-30% rubble, gravel or other stable habitat. Habitat availability less than desirable. 6-10	Less than 10% rubble gravel or other stable habitat. Lack of habitat is obvious. 0-5
2. Embeddedness ^(b)	Gravel, cobble, and boulder particles are between 0 and 25 % surrounded by fine sediment. 16-20	Gravel, cobble, and boulder particles are between 25 and 50 % surrounded by fine sediment. 11-15	Gravel, cobble, and boulder particles are between 50 and 75 % surrounded by fine sediment. 6-10	Gravel, cobble, and boulder particles are over 75 % surrounded by fine sediment. 0-5
3. ≤ 0.15 cms (5cfs) * *Flow _A at rep. low flow ^(a) or > 0.15 cms (5cfs) * Velocity/depth	Cold > 0.05 cms (2 cfs) Warm > 0.15 cms (5 cfs) 10-20	0.01-0.05 cms (1-2 cfs) 0.05-0.15 cms (2-5 cfs) 11-15	0.01-0.01 cms (.5-1 cfs) 0.03-0.05 cms (1-2 cfs) 6-10	< 0.01 cms (.5 cfs) < 0.03 cms (1 cfs) 0-5
	Slow (< 0.3 m/s), deep (> 0.5 m); slow, shallow (< 0.5 m); fast (> 0.3 m/s), deep; fast, shallow habitats all present. 16-20	Only 3 of the 4 habitat categories present (missing riffles or runs receive lower score than missing pools). 11-15	Only 2 of the 4 habitat categories present (missing riffles/runs receive lower score). 6-10	Dominated by one velocity/depth category (usually pool). 0-5
4. * Channel alteration ^(a)	Little or no enlargement of islands or point bars, and/or no channelization. 12-15	Some new increase in bar formation, mostly from coarse gravel; and/or some channelization present. 8-11	Moderate deposition of new gravel, coarse sand on old and new bars; pools partially filled w/silt; and/or embankments on both banks. 6-7	Heavy deposits of fine material, increased bar development; most pools filled w/silt; and/or extensive channelization. 0-3
5. Bottom scouring and deposition ^(a)	Less than 5% of the bottom affected by scouring and deposition. 12-15	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools. 8-11	30-50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools. 6-7	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. Only large rocks in riffle exposed. 0-3

(a) From Ball 1982.

(b) From Platts et al. 1983.

Note: * = Habitat parameters not currently incorporated into BIOS.

HABITAT ASSESSMENT FIELD DATA SHEET (cont.)

Blue River - Ritey Rd.

Habitat Parameter	Category			
	Excellent	Good	Fair	Poor
6. Pool/riffle, run/bend ratio (distance between riffles divided by stream width)	5-7. Variety of habitat. Deep riffles and pools.	7-15. Adequate depth in pools and riffles. Bends provide habitat.	15-25. Occasional riffle or bend. Bottom contours provide some habitat.	>25. Essentially a straight stream. Generally all flat water or shallow riffle. Poor habitat.
	12-15	8-11	6-7	0-3
7. Bank stability ^(a)	Stable. No evidence of erosion or bank failure. Side slopes generally <10%. Little potential for future problem.	Moderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40% on one bank. Slight potential in extreme floods.	Moderately unstable. Moderate frequency and size of erosional areas. Side slopes up to 60% on some banks. High erosion potential during extreme high flow.	Unstable. Many eroded areas. Side slopes >60% common. "Raw" areas frequent along straight sections and bends.
	9-10	6-8	3-5	0-2
8. Bank vegetative stability ^(b)	Over 80% of the streambank surfaces covered by vegetation or boulders and cobbles.	50-79% of the streambank surfaces covered by vegetation, gravel or larger material.	25-49% of the streambank surfaces covered by vegetation, gravel, or larger material.	Less than 25% of the streambank surfaces covered by vegetation, gravel, or larger material.
	9-10	6-8	3-5	0-2
9. Streamside cover ^(b)	Dominant vegetation is shrub.	Dominant vegetation is of tree form.	Dominant vegetation is grass or forbes.	Over 50% of the streambank has no vegetation and dominant material is soil, rock, bridge materials, culverts, or mine tailings.
	9-10	6-8	3-5	0-2
Column Totals				
Score	62		20	

PHYSICAL CHARACTERIZATION/WATER QUALITY
FIELD DATA SHEET

Site 4
Blue River - Hwy 30

PHYSICAL CHARACTERIZATION

RIPARIAN ZONE/INSTREAM FEATURES

Predominant Surrounding Land Use:

Forest Field/Pasture Agricultural Residential Commercial Industrial Other

Local Watershed Erosion: None Moderate Heavy

Local Watershed NPIS Pollution: No evidence Some Potential Sources Obvious Sources

Estimated Stream Width 5 m Estimated Stream Depth: Shallow 0.2 m Run 0.5 m Pool 0.5 m

High Water Mark 230 m Velocity >30 Dam Present: Yes No Channelized: Yes Yes No

Canopy Cover: Open Partly Open Partly Shaded Shaded

SEDIMENT/SUBSTRATE:

Sediment Odors: Normal Sewage Petroleum Chemical Anaerobic None Other

Sediment Oils: Absent Slight Moderate Profuse

Sediment Deposits: Sludge Sawdust Paper Fiber Sand Shell Shells Other

Are the undersides of stones which are not deeply embedded black? Yes No

Inorganic Substrate Components

Substrate Type	Diameter	Percent Composition in Sampling Area
Bedrock		
Boulder	>256-mm (10 in.)	
Cobble	64-256-mm (2.5-10 in.)	<u>10%</u>
Gravel	2-64-mm (0.1-2.5 in.)	<u>50%</u>
Sand	0.06-2.00-mm (gritty)	<u>20%</u>
Silt	0.004-0.06-mm	
Clay	<0.004-mm (clay)	

Organic Substrate Components

Substrate Type	Characteristic	Percent Composition in Sampling Area
Detritus	Sticks, Wood, Coarse Plant Material (CPOM)	<u>5%</u>
Muck-Mud	Black, Very Fine Organic (FPOM)	
Marl	Grey, Shell Fragments	

WATER QUALITY

Temperature 60 °F Dissolved Oxygen 9.1 pH 7.4 Conductivity Other

Instrument(s) Used

Stream Type: Coldwater

Water Odors: Normal Sewage Petroleum Chemical None Other

Water Surface Oils: Slick Sheen Globes Flecks None

Turbidity: Clear Slightly Turbid Turbid Opaque Water Color

WEATHER CONDITIONS

partly cloudy

PHOTOGRAPH NUMBER

OBSERVATIONS AND/OR SKETCH

HABITAT ASSESSMENT FIELD DATA SHEET (cont.)

Blue River - Hwy 30

Habitat Parameter	Category				
	Excellent	Good	Fair	Poor	
6. Pool/riffle, run/bend ratio (distance between riffles divided by stream width)	5-7. Variety of habitat. Deep riffles and pools.	7-15. Adequate depth in pools and riffles. Bends provide habitat.	15-25. Occasional riffle or bend. Bottom contours provide some habitat.	>25. Essentially a straight stream. Generally all flat water or shallow riffle. Poor habitat.	
	12-15	8-11	4-7	0-3	
7. Bank stability ^(a)	Stable. No evidence of erosion or bank failure. Side slopes generally 100%. Little potential for future problem.	Moderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40% on one bank. Slight potential in extreme floods.	Moderately unstable. Moderate frequency and size of erosional areas. Side slopes up to 60% on some banks. High erosion potential during extreme high flow.	Unstable. Many eroded areas. Side slopes 160% common. "Hav" areas frequent along straight sections and bends.	
	9-10	6-8	3-5	0-2	
8. Bank vegetative stability ^(b)	Over 80% of the streambank surfaces covered by vegetation or boulders and cobble.	50-79% of the streambank surfaces covered by vegetation, gravel or larger material.	25-49% of the streambank surfaces covered by vegetation, gravel, or larger material.	Less than 25% of the streambank surfaces covered by vegetation, gravel, or larger material.	
	9-10	6-8	3-5	0-2	
9. Streamside cover ^(b)	Dominant vegetation is shrub.	Dominant vegetation is of tree form.	Dominant vegetation is grass or forbes.	Over 50% of the streambank has no vegetation and dominant material is soil, rock, bridge materials, culverts, or mine tailings.	
	9-10	6-8	3-5	0-2	
Column Totals					
Score	73				
	26				

HABITAT ASSESSMENT FIELD DATA SHEET

Blue River - Hwy 30

Habitat Parameter	Category			
	Excellent	Good	Fair	Poor
1. *Bottom substrate/ available cover ^(a)	Greater than 50% rubble, gravel, submerged logs, undercut banks, or other stable habitat. 16-20	30-50% rubble, gravel or other stable habitat. Adequate habitat. 11-15	10-30% rubble, gravel or other stable habitat. Habitat availability less than desirable. 6-10	Less than 10% rubble gravel or other stable habitat. Lack of habitat is obvious. 0-5
2. Embeddedness ^(b)	Gravel, cobble, and boulder particles are between 0 and 25 % surrounded by fine sediment 16-20	Gravel, cobble, and boulder particles are between 25 and 50 % surrounded by fine sediment 11-15	Gravel, cobble, and boulder particles are between 50 and 75 % surrounded by fine sediment 6-10	Gravel, cobble, and boulder particles are over 75 % surrounded by fine sediment 0-5
3. {0.15 cms (5 cfs) + "flow" at rep. low flow ^(a) or >0.15 cms (5 cfs) + Velocity/depth	Cold >0.05 cms (2 cfs) Warm >0.15 cms (5 cfs) 10-20	0.01-0.05 cms (1-2 cfs) 0.05-0.15 cms (2-5 cfs) 11-15	0.01-0.01 cms (.5-1 cfs) 0.03-0.05 cms (1-2 cfs) 6-10	(0.01 cms (.5 cfs) (0.03 cms (1 cfs)) 0-5
	Slow (<0.3 m/s), deep (>0.5 m); slow, shallow (<0.5 m); fast (>0.3 m/s), deep; fast, shallow habitats all present. 16-20	Only 3 of the 4 habitat categories present (missing riffles or runs receive lower score than missing pools). 11-15	Only 2 of the 4 habitat categories present (missing riffles/runs receive lower score). 6-10	Dominated by one velocity/depth category (usually pool). 0-5
4. * Channel alteration ^(a)	Little or no enlarge- ment of islands or point bars, and/or no channelization. 12-15	Some new increase in bar formation, mostly from coarse gravel; and/or some channelization present. 8-11	Moderate deposition of new gravel, coarse sand on old and new bars; pools partially filled w/silt; and/or embank- ments on both banks. 7	Heavy deposits of fine material, increased bar development; most pools filled w/silt; and/or extensive channelization. 0-3
5. Bottom scouring and deposition ^(a)	Less than 5% of the bottom affected by scouring and deposition. 12-15	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools. 8-11	30-50% affected. Deposits and scour at obstructions, con- strictions and bends. Some filling of pools. 7	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. Only large rocks in riffle exposed. 0-3

(a) From Ball 1982.

(b) From Platts et al. 1983.

Note: * = Habitat parameters not currently incorporated into BIOS.

MACROINVERTEBRATE DATA SHEET

Type of Sampler _____
 Collection Depth _____
 Substrate Type Snag
 Remarks _____

Sample No. #2
 Date October 12, 1994
 Location Blue River at Hwy 33
Columbia City, IN.
 Station # Site 4
 Collector AnsBryghat S. Chafin

sorted by M. Broadus
 Identification by G. Bright

Enter Family and/or Genus and Species Name on Blank Line.

Organisms	No.	A.	I.
Diptera			
Chironomidae			
<i>Orthocladius obunbratus</i>	3		
<i>Thienemannia</i> sp.	1		
Other Simuliidae	2		
Trichoptera			
<i>Hydropsyche betteni</i>	64		
<i>H. chani</i>	1		
<i>Cheumatopsyche</i> spp.	3		
<i>Ceratomyche bifida</i>	3		
Plecoptera			
Ephemeroptera			
<i>Stenacron interpunctum</i>	1		
<i>Baetis brunneicolor</i>	17		
<i>B. flavistriga</i>	2		
Odonata			
Hemiptera			

	No.	A.	I.
Coleoptera			
<i>Macronychus glabratus</i>	1		
Neuroptera and Megaloptera			
Crustacea			
Oligochaeta			
Hirudinea			
Bivalvia			
Gastropoda			
<i>Ferrissia rivulans</i>	1		
<i>Physella</i> spp.	1		
Bryozoa			
Coelenterata			
Other			

A = Adult. I = Immature.

Total No. Organisms 100

Total No. Taxa

11 Genera

MACROINVERTEBRATE DATA SHEET

#1

pe of Sampler _____
 llection Depth _____
 bstrate Type Shag
 marks _____

Sample No. _____
 Date Oct. 12, 1994
 Location Blue River at Hwy 33
Columbia City, IN

Sorted by M. Brundage
G. Bright

Station # Site 4
 Collector ~~Brundage~~ G. Bright

Identification by G. Bright
 Enter Family and/or Genus and Species Name on Blank Line.

Organisms	No.	A.	I.
Tracheoptera			
Chironomidae			
<i>Orthocladius obumbratus</i>	5		
<i>Cricotopus bicinctus</i>	2		
<i>Paralauterborniella</i> sp.	1		
<i>Thienemanniella</i> sp.	1		
Simuliidae	5		
Trichoptera			
<i>Hydropsyche betteni</i>	35		
<i>H. clunensis</i>	5		
<i>Cheumatopsyche</i> spp.	5		
<i>Ceratomyza bifida</i>	8		
Psocoptera			
hemiptera			
<i>Baetis brunneicollis</i>	16		
<i>B. flavistriga</i>	10		
<i>Stenonema intermedium</i>	2		
<i>Stenonema vicarium</i>	1		
onata			
<i>Aeschna</i> sp.	1		
miptera			

= Adult, I = Immature

Total No. Organisms 100

Organisms	No.	A.	I.
Coleoptera			
<i>Macronychus glabratus</i>	2		
Neuroptera and Megaloptera			
Crustacea			
Oligochaeta			
Hirudinea			
Bivalvia			
Gastropoda			
<i>Ferrissia rivularis</i>	1		
Bryozoa			
Coelenterata			
Other			

Total No. Taxa 14 Genera

HABITAT ASSESSMENT FIELD DATA SHEET (cont.)

Eel R. - D/S

Habitat Parameter	Category				
	Excellent	Good	Fair	Poor	
6. Pool/riffle, run/bend ratio (distance between riffles divided by stream width)	5-7. Variety of habitat. Deep riffles and pools.	7-15. Adequate depth in pools and riffles. Bends provide habitat.	15-25. Occasional riffle or bend. Bottom contours provide some habitat.	>25. Essentially a straight stream. Generally all flat water or shallow riffle. Poor habitat.	
	12-15	8-11	4-7	0-1	
7. Bank stability ^(a)	Stable. No evidence of erosion or bank failure. Side slopes generally <10%. Little potential for future problem.	Moderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40% on one bank. Slight potential in extreme floods.	Moderately unstable. Moderate frequency and size of erosional areas. Side slopes up to 60% on some banks. High erosion potential during extreme high flow.	Unstable. Many eroded areas. Side slopes >60% common. "Hav" areas frequent along straight sections and bends.	
	9-10	6-8	3-5	0-2	
8. Bank vegetative stability	Over 80% of the streambank surfaces covered by vegetation or boulders and cobble.	50-79% of the streambank surfaces covered by vegetation, gravel or larger material.	25-49% of the streambank surfaces covered by vegetation, gravel, or larger material.	Less than 25% of the streambank surfaces covered by vegetation, gravel, or larger material.	
	9-10	6-8	3-5	0-2	
9. Streamside cover ^(b)	Dominant vegetation is shrub.	Dominant vegetation is of tree form.	Dominant vegetation is grass or forbes.	Over 50% of the streambank has no vegetation and dominant material is soil, rock, bridge materials, culverts, or mine tailings.	
	9-10	6-8	3-5	0-2	
Column Totals					
Score	80				

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HABITAT ASSESSMENT FIELD DATA SHEET

Eel R. - D/S

Habitat Parameter	Category			
	Excellent	Good	Fair	Poor
1. *Bottom substrate/ available cover ^(a)	Greater than 50% rubble, gravel, submerged logs, undercut banks, or other stable habitat. 16-20	30-50% rubble, gravel or other stable habitat. Adequate habitat. 11-15	10-30% rubble, gravel or other stable habitat. Habitat availability less than desirable. 6-10	Less than 10% rubble gravel or other stable habitat. Lack of habitat is obvious. 0-5
2. Embeddedness ^(b)	Gravel, cobble, and boulder particles are between 0 and 25 % surrounded by fine sediment 16-20	Gravel, cobble, and boulder particles are between 25 and 50 % surrounded by fine sediment 11-15	Gravel, cobble, and boulder particles are between 50 and 75 % surrounded by fine sediment 6-10	Gravel, cobble, and boulder particles are over 75 % surrounded by fine sediment 0-5
3. <0.15 cms (5cfs) * *flow ^(a) at rep. low flow or >0.15 cms (5cfs) * Velocity/depth	Cold >0.05 cms (2 cfs) Warm >0.15 cms (5 cfs) 10-20	0.01-0.05 cms (1-2 cfs) 0.05-0.15 cms (2-5 cfs) 11-15	0.01-0.03 cms (.5-1 cfs) 0.03-0.05 cms (1-2 cfs) 6-10	<0.01 cms (.5 cfs) <0.03 cms (1 cfs) 0-5
	Slow (<0.3 m/s), deep (>0.5 m); slow, shallow (<0.5 m); fast (>0.3 m/s), deep; fast, shallow habitats all present. 16-20	Only 3 of the 4 habitat categories present (missing riffles or runs receive lower score than missing pools). 11-15	Only 2 of the 4 habitat categories present (missing riffles/runs receive lower score). 6-10	Dominated by one velocity/depth category (usually pool). 0-5
4. * Channel alteration ^(a)	Little or no enlargement of islands or point bars, and/or no channelization. 12-15	Some new increase in bar formation, mostly from coarse gravel; and/or some channelization present. 8-11	Moderate deposition of new gravel, coarse sand on old and new bars; pools partially filled w/silt; and/or embankments on both banks. 6-7	Heavy deposits of fine material, increased bar development; most pools filled w/silt; and/or extensive channelization. 0-3
5. Bottom scouring and deposition	Less than 5% of the bottom affected by scouring and deposition. 12-15	5-10% affected. Scour at constrictions and where grades steepen. Some deposition in pools. 8-11	10-50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools. 6-7	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. Only large rocks in riffle exposed. 0-3

(a) From Hall 1982.

(b) From Platts et al. 1983.

Note: * = Habitat parameters not currently incorporated into BIOS.

PHYSICAL CHARACTERIZATION/WATER QUALITY
FIELD DATA SHEET

Eel R. - D/S (Site 6)

PHYSICAL CHARACTERIZATION

RIPARIAN ZONE/INSTREAM FEATURES

Predominant Surrounding Land Use:

Forest Field/Pasture Agricultural Residential Commercial Industrial Other _____

Local Watershed Erosion: None Moderate Heavy

Local Watershed BPS Pollution: No evidence Some Potential Sources Obvious Sources

Estimated Stream Width 10 m Estimated Stream Depth: 0.2 m Run _____ m Pool 1 m

High Water Mark _____ m Velocity >30 Dam Present: Yes _____ No ✓ Channelized: Yes ✓ No _____

Canopy Cover: Open Partly Open Partly Shaded Shaded

SEDIMENT/SUBSTRATE:

Sediment Odors: Normal Sewage Petroleum Chemical Anaerobic None Other _____

Sediment Oils: Absent Slight Moderate Profuse

Sediment Deposits: Sludge Sawdust Paper Fiber Sand Shell Shells Other _____

Are the undersides of stones which are not deeply embedded black? Yes No

Inorganic Substrate Components

Substrate Type	Diameter	Percent Composition in Sampling Area
Bedrock		
Boulder	>254-mm (10 in.)	
Cobble	64-254-mm (2.5-10 in.)	<u>2</u>
Gravel	2-64-mm (0.1-2.5 in.)	<u>30</u>
Sand	0.06-2.00-mm (gritty)	<u>50</u>
Silt	.004-.06-mm	
Clay	<.004-mm (silty)	<u>18</u>

Organic Substrate Components

Substrate Type	Characteristic	Percent Composition in Sampling Area
Detritus	Sticks, Wood, Coarse Plant Materials (CPOM)	<u>5%</u>
Muck-Mud	Black, Very Fine Organic (FPOM)	
Marl	Grey, Shell Fragments	

WATER QUALITY

Temperature _____ C Dissolved Oxygen _____ pH _____ Conductivity _____ Other _____

Instrument(s) Used _____

Stream Type: Coldwater Warmwater

Water Odors: Normal Sewage Stagnant Petroleum Chemical None Other _____

Water Surface Oils: Slick Sheen Globes Flochs None

Turbidity: Clear Slightly Turbid Turbid Opaque Water Color _____

WEATHER CONDITIONS

Sunny 6/2/94

PHOTOGRAPH NUMBER

OBSERVATIONS AND/OR SKETCH

HABITAT ASSESSMENT FIELD DATA SHEET (cont.)

Eel River - U/S

Habitat Parameter	Excellent	Good	Fair	Poor
6. Pool/riffle, run/bend ratio (distance between riffles divided by stream width)	5-7. Variety of habitat. Deep riffles and pools.	7-15. Adequate depth in pools and riffles. Bends provide habitat.	15-25. Occasional riffle or bend. Bottom contours provide some habitat.	>25. Essentially a straight stream. Generally all flat water or shallow riffle. Poor habitat.
	12-15	8-11	(4-7)	0-3
7. Bank stability (a)	Stable. No evidence of erosion or bank failure. Side slopes generally <10%. Little potential for future problem.	Moderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40% on one bank. Slight potential in extreme floods.	Moderately unstable. Moderate frequency and size of erosional areas. Side slopes up to 60% on some banks. High erosion potential during extreme high flow.	Unstable. Many eroded areas. Side slopes >60% common. "Raw" areas frequent along straight sections and bends.
	9-10	6-8	(4-5)	0-2
8. Bank vegetative stability (b)	Over 80% of the streambank surfaces covered by vegetation or boulders and cobbles.	50-79% of the streambank surfaces covered by vegetation, gravel or larger material.	25-49% of the streambank surfaces covered by vegetation, gravel, or larger material.	Less than 25% of the streambank surfaces covered by vegetation, gravel, or larger material.
	9-10	(6-8)	3-5	0-2
9. Streamside cover (b)	Dominant vegetation is shrub.	Dominant vegetation is of tree form.	Dominant vegetation is grass or forbes.	Over 50% of the streambank has no vegetation and dominant material is soil, rock, bridge materials, culverts, or mine tailings.
	9-10	6-8	(4-5)	0-2
Column Totals				
Score	69			25

HABITAT ASSESSMENT FIELD DATA SHEET

Eel River - U/S

Habitat Parameter	Category			
	Excellent	Good	Fair	Poor
1. *Bottom substrate/available cover ^(a)	Greater than 50% rubble, gravel, submerged logs, undercut banks, or other stable habitat. 16-20	30-50% rubble, gravel or other stable habitat. Adequate habitat. 11-15	10-30% rubble, gravel or other stable habitat. Habitat availability less than desirable. 6-10	Less than 10% rubble, gravel or other stable habitat. Lack of habitat is obvious. 0-5
2. Embeddedness ^(b)	Gravel, cobble, and boulder particles are between 0 and 25 % surrounded by fine sediment 16-20	Gravel, cobble, and boulder particles are between 25 and 50 % surrounded by fine sediment 11-15	Gravel, cobble, and boulder particles are between 50 and 75 % surrounded by fine sediment 6-10	Gravel, cobble, and boulder particles are over 75 % surrounded by fine sediment 0-5
3. <0.15 cms (5cfs) * *Flow ^(a) at rep. low flow or >0.15 cms (5cfs) * Velocity/depth	Cold >0.05 cms (2 cfs) Warm >0.15 cms (5 cfs) 10-20	0.03-0.05 cms (1-2 cfs) 0.05-0.15 cms (2-5 cfs) 11-15	0.01-0.03 cms (.5-1 cfs) 0.03-0.05 cms (1-2 cfs) 6-10	<0.01 cms (.5 cfs) <0.03 cms (1 cfs) 0-5
	Slow (<0.3 m/s), deep (>0.5 m); slow, shallow (<0.5 m); fast (>0.3 m/s), deep; fast, shallow habitats all present. 16-20	Only 3 of the 4 habitat categories present (missing riffles or runs receive lower score than missing pools). 11-15	Only 2 of the 4 habitat categories present (missing riffles/runs receive lower score). 6-10	Dominated by one velocity/depth category (usually pool). 0-5
4. * Channel alteration ^(a)	Little or no enlargement of islands or point bars, and/or no channelization. 12-15	Some new increase in bar formation, mostly from coarse gravel; and/or some channelization present. 8-11	Moderate deposition of new gravel, coarse sand on old and new bars; pools partially filled w/silt; and/or embankments on both banks. 6-7	Heavy deposits of fine material, increased bar development; most pools filled w/silt; and/or extensive channelization. 0-3
5. Bottom scouring and deposition ^(a)	Less than 5% of the bottom affected by scouring and deposition. 12-15	5-10% affected. Scour at constrictions and where grades steepen. Some deposition in pools. 8-11	10-50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools. 6-7	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. Only large rocks in riffle exposed. 0-3

(a) From Ball 1982.

(b) From Platts et al. 1981.

Note: * = Habitat parameters not currently incorporated into BIOS

PHYSICAL CHARACTERIZATION/WATER QUALITY
FIELD DATA SHEET

Site 5
El River - U/S - CR 2005

PHYSICAL CHARACTERIZATION

RIPARIAN ZONE/INSTREAM FEATURES

Predominant Surrounding Land Use:

Percent Field/Pasture Agricultural Residential Commercial Industrial Other

Local Watershed Erosion: None Moderate Heavy

Local Watershed BPS Pollution: No evidence Some Potential Sources Obvious Sources

Estimated Stream Width 10 m Estimated Stream Depth: Riffle 0.5 m Run 1 m Pool 1 m

High Water Mark 30 m Velocity >30 cm Present: Yes No Channelized: Yes Yes No

Canopy Cover: Open Partly Open Partly Shaded Shaded

SEDIMENT/SUBSTRATE:

Sediment Odors: Normal Sewage Petroleum Chemical Anaerobic None Other

Sediment Oils: Absent Slight Moderate Profuse

Sediment Deposits: Sludge Sawdust Paper Fiber Sand Shell Shells Other

Are the undersides of stones which are not deeply embedded black? Yes No

Inorganic Substrate Components

Substrate Type	Diameter	Percent Composition in Sampling Area
Bedrock		
Boulder	>256-mm (10 in.)	1
Cobble	64-256-mm (2.5-10 in.)	9
Gravel	2-64-mm (0.1-2.5 in.)	6
Sand	0.06-2.00-mm (gritty)	30
Silt	.004-.06-mm	
Clay	<.004-mm (clay)	

Organic Substrate Components

Substrate Type	Characteristic	Percent Composition in Sampling Area
Detritus	Sticks, Wood, Coarse Plant Materials (CPOM)	1%
Muck-Mud	Black, Very Fine Organic (FPOM)	
Shell	Grey, Shell Fragments	

WATER QUALITY

Temperature C Dissolved Oxygen ppm Conductivity Other

Instrument(s) Used

Stream Type: Coldwater Warmwater

Water Odors: Normal Sewage Petroleum Chemical None Other

Water Surface Oils: Slick Sheen Globs Flocks None

Turbidity: Clear Slightly Turbid Turbid Opaque Water Color

WEATHER CONDITIONS

PHOTOGRAPH NUMBER

OBSERVATIONS AND/OR SKETCH

HABITAT ASSESSMENT FIELD DATA SHEET

Blue River - u/s

Habitat Parameter	Excellent	Good	Fair	Poor
1. *Bottom substrate/available cover ^(a)	Greater than 50% rubble, gravel, submerged logs, undercut banks, or other stable habitat. 16-20	30-50% rubble, gravel or other stable habitat. Adequate habitat. 11-15	10-30% rubble, gravel or other stable habitat. Habitat availability less than desirable. 6-10	Less than 10% rubble gravel or other stable habitat. Lack of habitat is obvious. 0-5
2. Embeddedness ^(b)	Gravel, cobble, and boulder particles are between 0 and 25 % surrounded by fine sediment 16-20	Gravel, cobble, and boulder particles are between 25 and 50 % surrounded by fine sediment 11-15	Gravel, cobble, and boulder particles are between 50 and 75 % surrounded by fine sediment 6-10	Gravel, cobble, and boulder particles are over 75 % surrounded by fine sediment 0-5
3. ≤ 0.15 cms (5cfs) * *Flow ₁ at rep. low flow	Cold > 0.05 cms (2 cfs) Warm > 0.15 cms (5 cfs) 10-20	0.01-0.05 cms (1-2 cfs) 0.05-0.15 cms (2-5 cfs) 11-15	0.01-0.03 cms (.5-1 cfs) 0.03-0.05 cms (1-2 cfs) 6-10	< 0.01 cms (.5 cfs) < 0.03 cms (1 cfs) 0-5
or > 0.15 cms (5cfs) * Velocity/depth	Slow (< 0.3 m/s), deep (> 0.5 m); slow, shallow (< 0.5 m); fast (> 0.3 m/s), deep; fast, shallow habitats all present. 16-20	Only 3 of the 4 habitat categories present (missing riffles or runs receive lower score than missing pools). 11-15	Only 2 of the 4 habitat categories present (missing riffles/runs receive lower score). 6-10	Dominated by one velocity/depth category (usually pool). 0-5
4. * Channel alteration ^(a)	Little or no enlargement of islands or point bars, and/or no channelization. 12-15	Some new increase in bar formation, mostly from coarse gravel; and/or some channelization present. 8-11	Moderate deposition of new gravel, coarse sand on old and new bars; pools partially filled w/silt; and/or embankments on both banks. 4-7	Heavy deposits of fine material, increased bar development; most pools filled w/silt; and/or extensive channelization. 0-3
5. Bottom scouring and deposition ^(a)	Less than 5% of the bottom affected by scouring and deposition. 12-15	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools. 8-11	30-50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools. 4-7	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. Only large rocks in riffle exposed. 0-3

(a) From Ball 1982.

(b) From Platts et al. 1983.

Note: * = Habitat parameters not currently incorporated into BIOS.

HABITAT ASSESSMENT FIELD DATA SHEET (cont.)

Blue River - U/S

Habitat Parameter	Category			
	Excellent	Good	Fair	Poor
6. Pool/riffle, run/bend ratio (distance between riffles divided by stream width)	5-7. Variety of habitat. Deep riffles and pools.	7-15. Adequate depth in pools and riffles. Bends provide habitat.	15-25. Occasional riffle or bend. Bottom contours provide some habitat.	>25. Essentially a straight stream. Generally all flat water or shallow riffle. Poor habitat.
	12-15	8-11	4-7	0-3
7. Bank stability ^(a)	Stable. No evidence of erosion or bank failure. Side slopes generally <30%. Little potential for future problem.	Moderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40% on one bank. Slight potential in extreme floods.	Moderately unstable. Moderate frequency and size of erosional areas. Side slopes up to 60% on some banks. High erosion potential during extreme high flow.	Unstable. Many eroded areas. Side slopes >60% common. "Raw" areas frequent along straight sections and bends.
	9-10	6-8	1-5	0-2
8. Bank vegetative stability ^(b)	Over 40% of the streambank surfaces covered by vegetation or boulders and cobble.	50-79% of the streambank surfaces covered by vegetation, gravel or larger material.	25-49% of the streambank surfaces covered by vegetation, gravel, or larger material.	Less than 25% of the streambank surfaces covered by vegetation, gravel, or larger material.
	9-10	6-8	1-5	0-2
9. Streamside cover ^(b)	Dominant vegetation is shrub.	Dominant vegetation is of tree form.	Dominant vegetation is grass or forbes.	Over 50% of the streambank has no vegetation and dominant material is soil, rock, bridge materials, culverts, or mine tailings.
	9-10	6-8	1-5	0-2
Column Totals	Score 91	35		

Metric Values

	Sample 1	Sample 2
Total Genera	14	11
EPT Genera	6	5
Scrapers/Filterers	0.07	0.04
% Dominant Taxon	35	64
EPT/Chironomids	9.1	22
Community Loss Index	1.2	1.5
Hilsenhoff Biotic Index	6.1	7.0
% Shredders in CPOM	0	0

Site Scores in Relation to the Reference

	Sample 1	Sample 2
Total Genera	4	2
EPT Genera	6	6
Scrapers/Filterers	0	0
% Dominant Taxon	2	0
EPT/Chironomids	6	6
Community Loss Index	4	4
Hilsenhoff Biotic Index	4	4
% Shredders in CPOM	0	0
	----	----
	26	22

Mean Site Score = 24

Each duplicate is within 10% of the mean

Tippecanoe River
Reference
Site 1



Blue River
Highway 33
Site 2



Blue River
Riley Road
Site 3



Blue River
Highway 30
Site 4



Eel River
CR 200 S
Site 5



Eel River
Washington Road
Site 6

